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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61B 17/80	A1	(11) International Publication Number: WO 99/09903
		(43) International Publication Date: 4 March 1999 (04.03.99)

(21) International Application Number: PCT/EP97/04669

(22) International Filing Date: 27 August 1997 (27.08.97)

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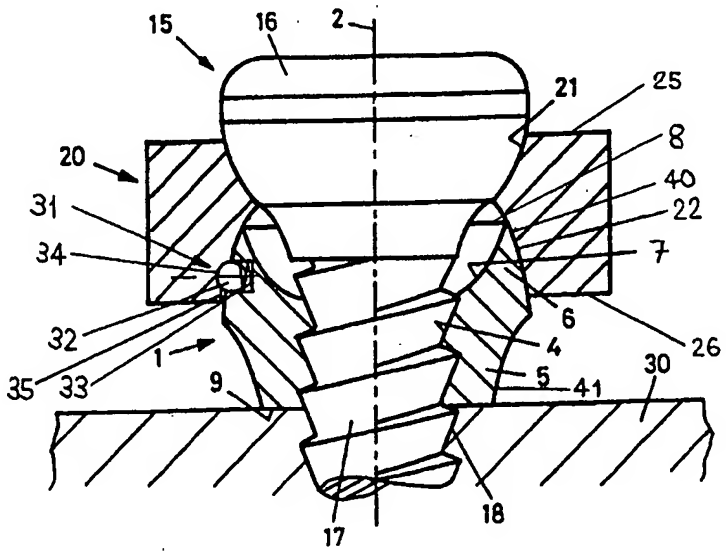
(81) Designated States: CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: LOCKING RING WITH BAYONET FOR PLATE OSTEOSYNTHESIS



(57) Abstract

A system for osteosynthesis comprises an osteosynthetic bone plate (20) and a locking ring (1), said bone plate (20) having a plurality of bore holes (12) having a taper (21) adjacent to said upper side (25) to engage the head (16) of a bone screw (15) and a taper (22) adjacent to said lower side (26) to engage the upper part (6) of said locking ring (1), and said locking ring (1) has a coaxial bore hole (12) with a thread (4). A bayonet joint comprising at least one detent (31) is attached to the upper part (6) of the locking ring (1) or placed in the bore hole (12) of the bone plate (20) and can be engaged by a groove (35, 38) in the bore hole (12) of the bone plate (20) or in the upper part (6) of the locking ring (1) and the detent (31) can fit in a recess (34, 37, 39) at the end of said groove (35, 38) thereby preventing rotation of said locking ring (1).

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LOCKING RING WITH BAYONET FOR PLATE OSTEOSYNTHESIS

The invention relates to an osteosynthetic system comprising an osteosynthetic bone plate and a locking ring according to claim 1 and independent claim 6.

Many bone plates employed in osteosynthesis are attached directly to the bone only by bone screws, and are held to the bone solely by the bone screw and the resulting friction between the bone plate and the bone. In such situations the bone screws are not fixed rigidly to the bone plate because the bone screws are simply anchored in the bone. Loosening the screws in the bone or a resorption of the bone can, therefore, easily lead to a loosening of the bone plate itself.

For example, certain known bone plate screws pass completely through the bone to be secured by a nut attached to the end of the screw that is remote from the head of the screw. This method, however, does not provide any direct fixation between the screw and the plate. Rather, it causes a compression of the bone lying between the nut and the plate.

Nevertheless, in some situations, it is desirable to fix the bone screw rigidly to the bone plate to avoid any subsequent loosening. A screw nut designed for the rigid fixation of a bone screw to a bone plate is disclosed in US 5,269,784 MAST.

In general the present invention features a locking ring for attaching a bone screw to a bone plate. The locking ring includes a body having a central axis and a bore hole having an internal threading for receiving the bone screw. The locking ring includes a lower section adapted to abut the surface of the bone, and an upper section shaped to be retained in a plate bore hole. The locking ring can be removeably attached to the bone plate with a bayonet joint which also prevents the locking ring from rotation when the bone screw is tightened.

It is also desirable to reduce the contact surface adjoining the bone for purpose of improving vascularity in a manner that minimizes damage to the bone surface. The average width or diameter of the lower section of the locking ring is preferably less than the average width or diameter of the upper section. Various implementations and features of the locking ring are described in detail below.

In various implementations the invention provides one or more of the following advantages. The locking ring can be used with multiple types of bone plates and bone screws. Additionally, use

of the locking ring can be limited to specific boreholes in the bone plate depending upon the particular application. The locking ring can, therefore, be used intraoperatively as well.

The locking ring can also serve as a spacer between the bone plate and the bone. The reduced contact surface permits improved blood flow and thus, quicker healing.

In addition, by using the locking ring, it is possible to place the bone plate at a specified distance from the bone, resulting in a so-called ultra-low profile external fixator. Furthermore, the rigid fixation prevents undesired deformities, which can occur with axial compression upon rotation of the screw. The locking ring also permits a certain degree of energy storage when pressure is exerted on the fracture. Thus, it is possible to exert a compression effect which lasts longer. Such energy storage can also remove the load on screws, such as tension bolts, that are positioned in the conventional way through a bone plate. In addition, the locking ring allows the bone screw to tilt laterally relative to the central axis of the bone plate hole without providing additional accessoires.

The locking ring and the bone plate can be employed in the following exemplary ways:

a) With osteoporotic bones or bones with a thin corticallis. A premature loosening, which occasionally takes place through ciclic loading, can be avoided because a rigid fixation is present between the plate and the screw.

b) With a bone defect in the superficial corticalis, which can appear, for example, with a comminuted fracture in the bone.

c) With an indication of former "blade plates".

Additional features and advantages of the invention will be evident from the detailed description and accompanying drawings.

Brief description of the drawings:

Fig. 1 shows an exploded perspective of an osteosynthetic system according to one implementation of the invention;

Fig. 2 is a cross-sectional view illustrating the osteosynthetic system according to one implementation of the invention;

Fig. 3 is a cross-sectional view illustrating the bore hole in the bone plate according to one implementation of the invention;

Fig. 4 is a top view to a section of the bone plate comprising a bore hole according to one implementation of the invention;

Fig. 5 is a cross-sectional view illustrating the bore hole in the bone plate according to another implementation of the invention; and

Fig. 6 is a cross-sectional view illustrating the osteosynthetic system according to one implementation of the invention;

Fig. 1 and 2 illustrate an implementation of an osteosynthetic system according to the invention consisting of a bone plate 20, a locking ring 1 and a bone screw 15. The locking ring 1 is an unitary piece having a central axis 2, a upper part 6, a lower part 5 and an interior, coaxial bore hole 3 with a thread 4 adjoining the lower side 9 and a taper 3 widening towards the upper side 8. The thread 4 matches an external threading 18 on the shaft 17 of the bone screw 15. The lower part 5 has a taper 41 narrowing towards the lower side 9 adjacent to the bone 30. The upper part 6 has also a taper 40 narrowing towards the upper side 8 and comprises a detent 31 consisting of a spring 33 and a sphere 32. The average outer diameter of the lower part 5 is smaller than the average outer diameter of the upper part 6, thereby providing a relatively small lower side 9 for contact with the bone 30.

The bone plate 20 has at least one bore hole 12 which extends substantially perpendicular from the upper side 25 to the lower side 26. The bore hole 12 has one taper 22 widening towards the lower side 26 to engage the tapered upper part 6 of the locking ring 1 and another taper 21 widening towards the upper side 25 of the bone plate 20 to engage the head 16 of the bone screw 15. The taper 22 adjoining the lower side 26 provides at least one groove 35 extending parallel to the central axis 2 from the lower side 26 having a recess 34 at its end. The groove 35 and the recess 34 are shaped such that the detent 31 can be engaged by the groove 35 and releasably fit in the recess 34, thereby preventing rotation of the locking ring 1 when the bone screw 15 is tightened.

Fig. 3 shows one implementation of the bore hole 12 in the bone plate 20 with a taper 21 widening towards the upper side 25 of the bone plate 20, another taper 22 widening towards the lower side 26 of the bone plate 20 and a groove 35 extending parallel to the central axis 2 from the lower side 26 with a sperical recess 34 at its end. The groove 35 and the recess 34 are shaped such that the detent 31 can be engaged by the groove 35 and releasably fit in the recess 34, thereby preventing rotation of the locking ring 1 when the bone screw 15 is tightened.

Fig. 4 and 5 illustrate another implementation of the bore hole 12 in the bone plate 20. The bore hole 12 has an upper taper 21 widening towards the upper side 25 of the bone plate 20 and another taper 22 widening towards the lower side 26 of the bone

plate 20. The taper 22 provides a groove 35 extending parallel to the central axis 2 from the lower side 26 with a recess 37 at its end which has a increasing depth with its circumferential extending. The groove 35 and the recess 37 are shaped such that the detent 31 can be engaged by the groove 35 and releasably fit in the recess 37, thereby preventing rotation of the locking ring 1.

Fig. 6 illustrates an implementation of an osteosynthetic system according to the invention consisting of a bone plate 20, a locking ring 1 and a bone screw 15. The locking ring 1 is an unitary piece having a central axis 2, a upper part 6, a lower part 5 and an interior, coaxial bore hole 3 with a thread 4 adjoining the lower side 9 and a taper 3 widening towards the upper side 8. The thread 4 matches an external threading 18 on the shaft 17 of the bone screw 15. The lower part 5 has a taper 41 narrowing towards the lower side 9 adjacent to the bone 30. The upper part 6 has also a taper 40 narrowing towards the upper side 8. The average outer diameter of the lower part 5 is smaller than the average outer diameter of the upper part 6, thereby providing a relatively small lower side 9 for contact with the bone 30.

The bone plate 20 has at least one bore hole 12 which extends substantially perpendicular from the upper side 25 to the lower side 26. The bore hole 12 has one taper 22 widening towards the

lower side 26 to engage the tapered upper part 6 of the locking ring 1 and another taper 21 widening towards the upper side 25 of the bone plate 20 to engage the head 16 of the bone screw 15.

The bone plate 20 comprises at least one detent 31 that is set in the taper 22 of the bore hole 12. The detent 31 consists of a spring 33 and a spere 32 and can be engaged by a groove 38 that is located on the upper part 6 of said locking ring 1 and the detent 31 can fit releasably in a recess 39 at the end of the groove 38 thereby preventing rotation of the locking ring 1..

Claims

1. A system for osteosynthesis comprising an osteosynthetic bone plate (20) and a locking ring (1), said bone plate (20) having an upper side (25), a lower side (26) and a plurality of bore holes (12) having a central axis (2), a taper (21) adjacent to said upper side (25) to engage the head (16) of a bone screw (15) and a taper (22) adjacent to said lower side (26) to engage the upper part (6) of said locking ring (1), and said locking ring (1) having a central axis (2), an upper part (6) with a taper (40) that becomes smaller towards the upper side (8) of said locking ring (1), a lower part (5) with a taper (41) that becomes smaller towards the lower side (9) adjacent to the bone (30) and a coaxial bore hole (12) having a thread (4) adjoining said lower side (9) and a taper (3) with its widest end adjacent to said upper side (8),
characterised in that
said upper part (6) comprises at least one detent (31) that can be engaged by a groove (35) in the bore hole (12) of a bone plate (20) and said detent (31) can fit in a recess (34, 37) at the end of said groove (35) thereby preventing rotation of said locking ring (1).

2. A system for osteosynthesis as claimed in claim 1, characterised in that the upper part (6) of said locking ring (1) is sperically tapered.

3. A system for osteosynthesis according to claim 1 or 2, charactrised in that the recess (34) is hemispherical.

4. A system for osteosynthesis according to one of the claims 1 to 3, characterised in that each bore hole (12) provides n grooves (35) distributet at the circumference of the lower taper (22) of the bore hole (12) having an angle of $\beta = 360^{\circ}/n$ between each other.

5. A system for osteosynthesis as claimed in claim 4, characterised in that the locking ring (1) provides m detents (31) distributet at the circumference of the upper part (6) of the locking ring (1) having an angle of $\alpha = 360^{\circ}/m$ between each other.

6. A system for osteosynthesis comprising an osteosynthetic bone plate (20) and a locking ring (1), said bone plate (20) having an upper side (25), a lower side (26) and a plurality of bore holes (12) having a central axis (2), a taper (21) adjacent to said upper side (25) to engage the head (16) of a bone screw (15) and a taper (22) adjacent to said lower side (26) to engage the upper part (6) of said locking ring (1), and said locking ring (1) having a central axis (2), an upper part (6) with a taper (40) that becomes smaller towards the upper side (8) of said locking ring (1), a lower part (5) with a taper (41) that becomes smaller towards the lower side (9) adjacent to

the bone (30) and a coaxial bore hole (12) having a thread (4) adjoining said lower side (9) and a taper (3) with its widest end adjacent to said upper side (8),

characterised in that

said bone plate (20) comprises at least one detent (31) that is set in said taper (22) of said bore hole (12) and can be engaged by a groove (38) that is located on said upper part (6) of said locking ring (1) and said detent (31) can fit in a recess (39) at the end of said groove (38) thereby preventing rotation of said locking ring (1).

7. A system for osteosynthesis as claimed in claim 6, charactrised in that the recess (39) is hemispherical.

8. A system for osteosynthesis according to claim 6 or 7, characterised in that the locking ring (1) provides n grooves (38) distributed at the circumference of the upper part (6) of the locking ring (1) having an angle of $\beta = 360^{\circ}/n$ between each other.

9. A system for osteosynthesis as claimed in claim 8, characterised in that the bone plate (20) provides m detents (31) distributed at the circumference of the lower taper (22) of the bore hole (12) having an angle of $\alpha = 360^{\circ}/m$ between each other.

Fig. 1

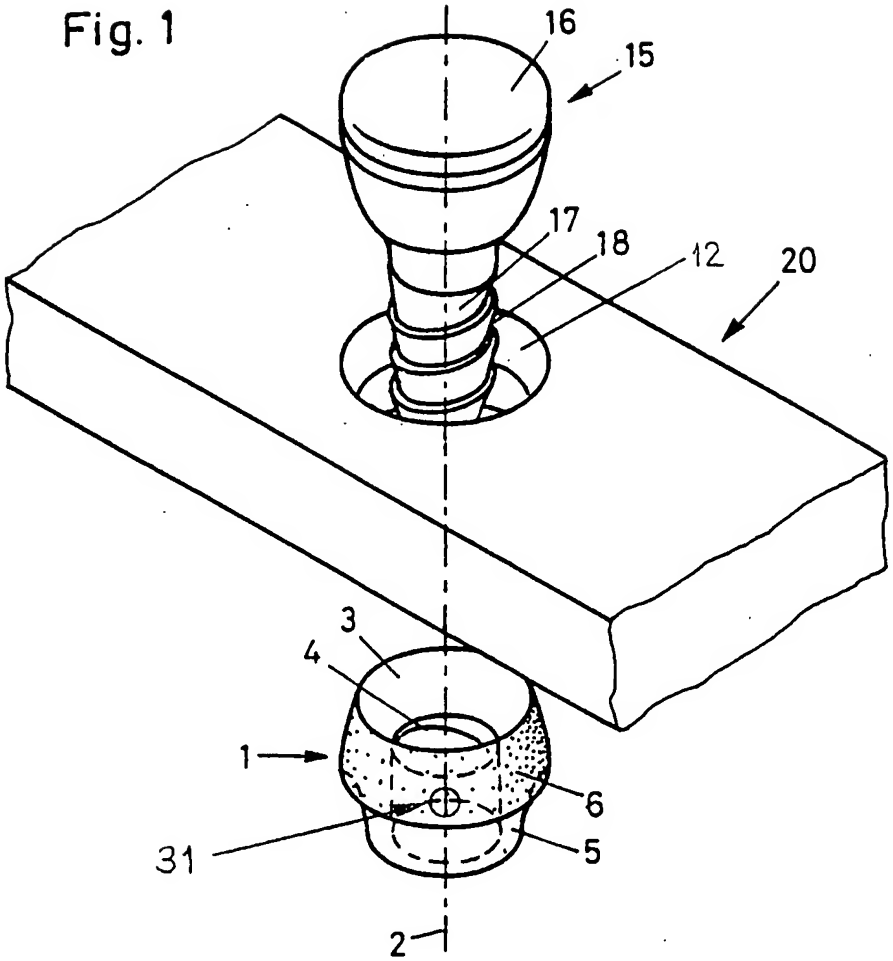
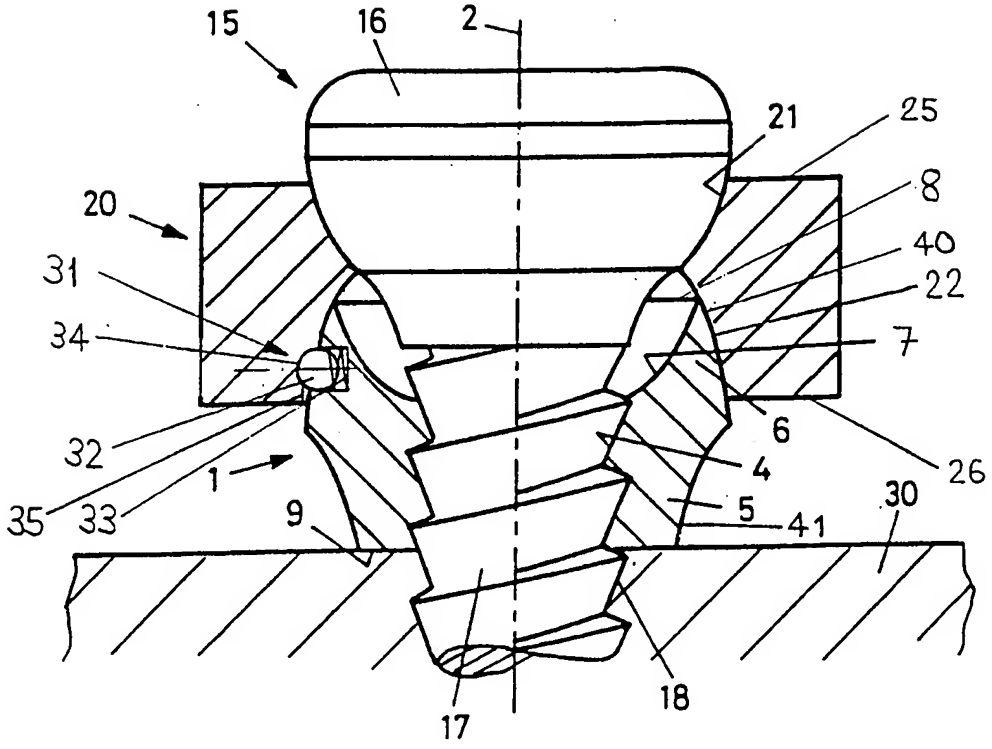


Fig. 2



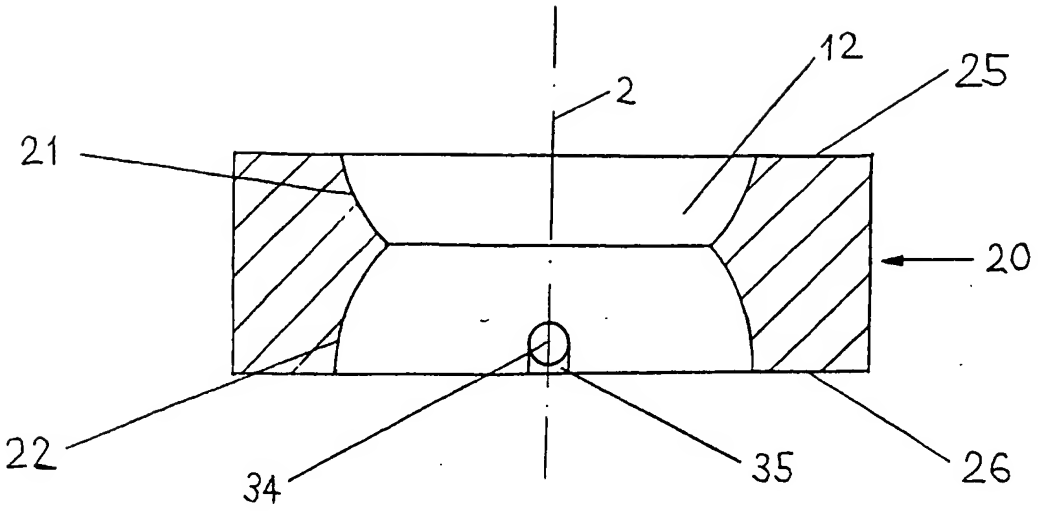


Fig. 3

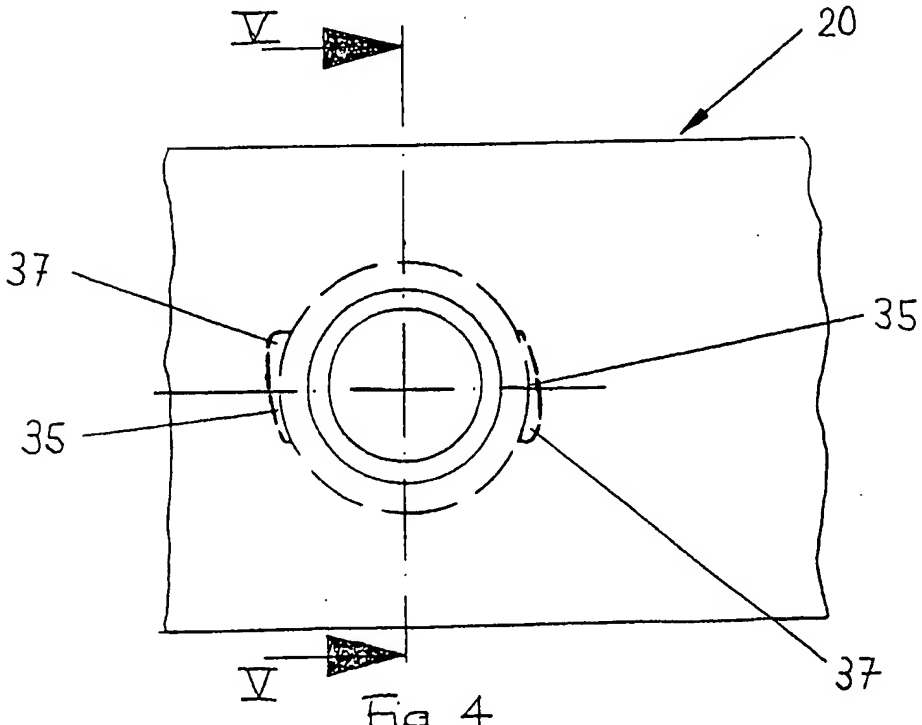


Fig. 4

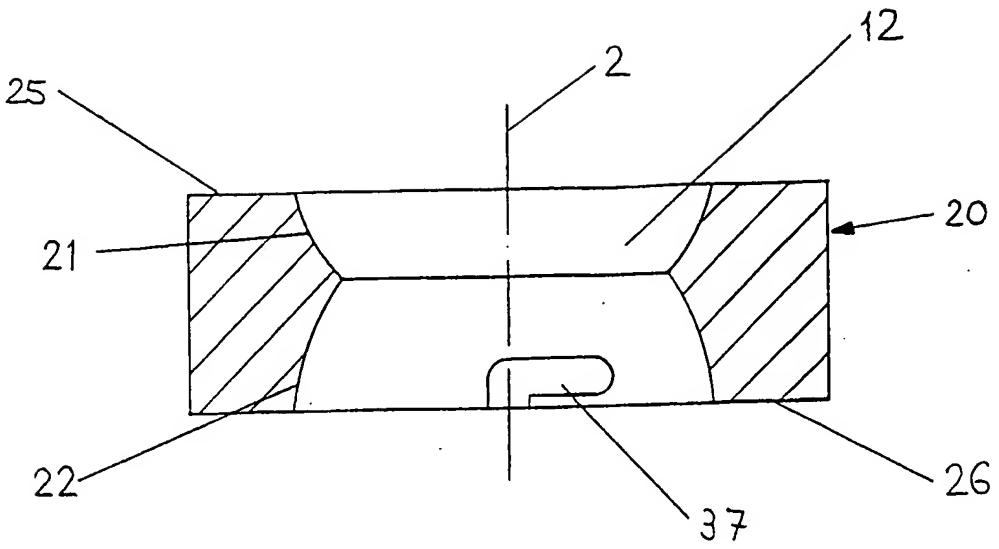


Fig. 5

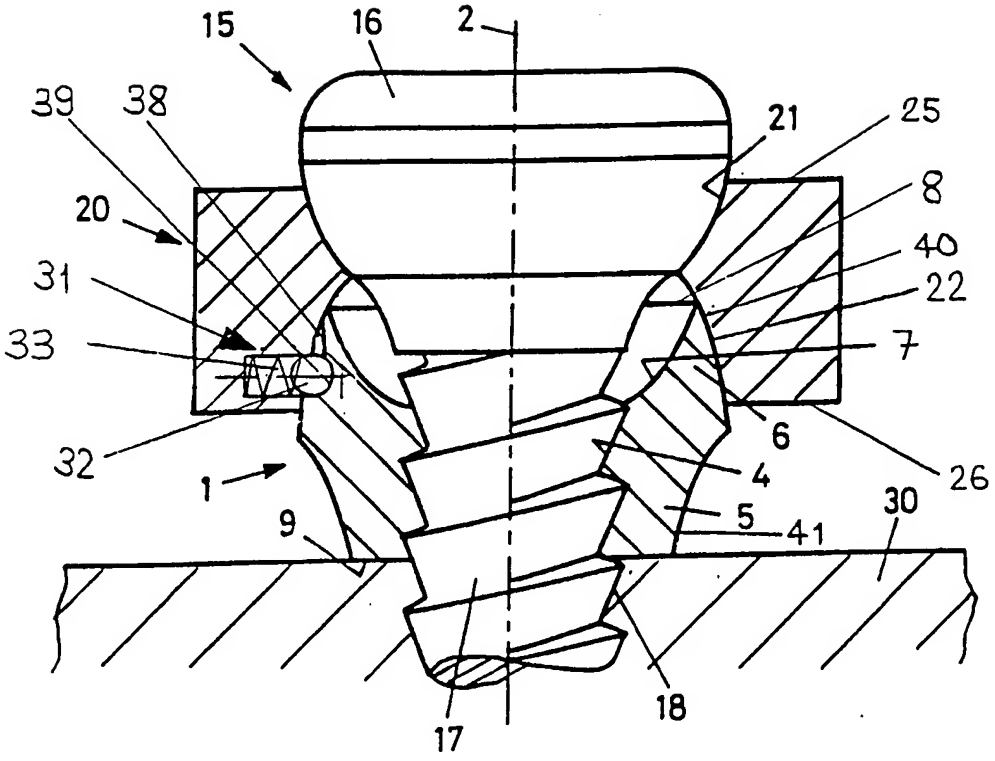


Fig. 6

INTERNATIONAL SEARCH REPORT

Int. ional Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61B17/80

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61B

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 16634 A (SYNTHES) 4 August 1994 see page 3, line 14 - page 4, line 15; figure 2	1-9
A	US 5 269 784 A (J.W.MAST) 14 December 1993 cited in the application see column 2, line 19 - line 27 see column 5, line 19 - line 30; figures 2,7	1,6
A	EP 0 633 007 A (SMITH & NEPHEW DONJOY) 11 January 1995 see column 1, line 45 - line 49	1,6

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